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**United States Patent** [19]

Kondo et al.

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[54] **PROCESS FOR PRODUCING HIGH-STRENGTH SEAMLESS STEEL PIPE HAVING EXCELLENT SULFIDE STRESS CRACKING RESISTANCE**

[75] **Inventors:** Kunio Kondo; Takahiro Kushida, both of Osaka; Hajime Osako; Hideki Takabe, both of Wakayama, all of Japan

[73] **Assignee:** Sumitomo Metal Industries, LTC., Osaka, Japan

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[58] **Field of Search** 148/593

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*Primary Examiner*—Deborah Yee  
*Attorney, Agent, or Firm*—Armstrong, Westerman, Hattori, McLeland & Naughton

[57] **ABSTRACT**

A process for producing a seamless steel pipe wherein pipe manufacturing steps and the heat treatment steps are carried out in one production line. The properties of the pipe are comparative or superior to those of the pipe manufactured in the conventional reheating, quenching and tempering process. The process is characterized by using the billet of a low alloy steel containing C: 0.15–0.50%, Cr: 0.1–1.5%, Mo: 0.1–1.5%, Al: 0.005–0.50%, Ti: 0.005–0.50% and Nb: 0.003–0.50%, and comprising the following steps (1) to (5).

- (1) hot rolling with 40% or more of cross sectional reduction ratio,
- (2) finishing the hot rolling in a temperature range of 800–1100° C.,
- (3) putting the manufactured steel pipe promptly in a complementary heating apparatus after the finish rolling, and complementarily heating at the temperature and time satisfying the following formula (a).
- (4) quenching the steel pipe immediately after taking out of the complementary heating apparatus, and
- (5) tempering the pipe at a temperature not higher than the  $A_{c1}$  transformation point as the last heat treatment.

$$23500 \leq (T+273) \times (21 + \log t) \leq 26000 \quad (a)$$

where, T (°C.) is a temperature of not lower than 850° C., and t is time (hr). Further, an intermediate heat treatment consisting of quenching or combination of quenching and tempering may be applied between the steps (4) and (5).

**7 Claims, 8 Drawing Sheets**